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Evaporation and Salinity Survey in French Polynesia

In 1979 the quantity of surface temperature and salinity data measured throughout French Polynesia by military and merchant ships was large enough to describe the development of the thermohaline structure of the surface layer. Data from the ships-of-opportunity organized by ORSTOM (Donguy *et al.*, 1978) supplemented daily measurements from five coastal stations in Tahiti and the eastern portion of the Tuamotu Archipelago (Figure 1). In addition, data were recorded at 15 stations of the French Meteorological and Civil Aviation Bureau located on atolls or coastal strips of high islands.

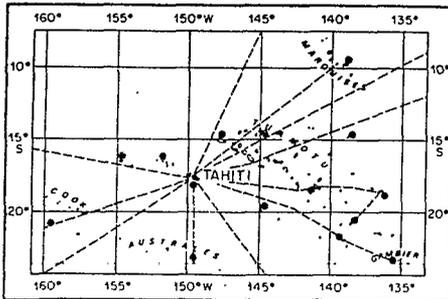


FIGURE 1 (Rougerie)

Locations of ships-of-opportunity tracks and coastal stations.

Daily values of evaporation-precipitation (E-P) were computed for the marine zone of French Polynesia during 1979 (Figure 2). The evaporation, E, represents the potential evapotranspiration calculated according to Penman's (1948) method from atmospheric temperature and humidity, wind speed, insolation and albedo. E and P are expressed in mm of water. In Figure 2 the zero-isoline of E-P, which represents the region where evaporation equals the amount of rainfall, separated two distinct zones: a zone in the eastern Tuamotu where the excess evaporation (*i.e.*, E-P is positive) reached 500 mm per year, in agreement with Dietrich's (1957) result; and a zone encompassing the Society and Austral Island Groups where excess precipitation (*i.e.*, E-P is negative) was 400-800 mm per year.

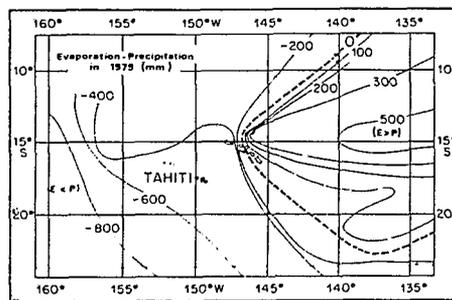


FIGURE 2 (Rougerie)

Evaporation-precipitation (mm per year) in 1979.

Surface salinity is influenced by a number of processes, such as horizontal advection, upwelling and the difference between evaporation and precipitation. The surface salinity distribution of the marine zone of French Polynesia in 1979 (Figure 3) corresponded very well to the E-P distribution, suggesting that the salt distribution was produced by E-P. In the eastern Tuamotu, water with surface salinities higher than 36.5‰ was typical of south tropical water formed by excessive evaporation. West of Tahiti, salinities were less than

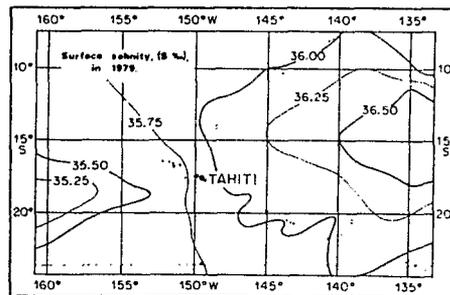


FIGURE 3 (Rougerie)

Sea surface salinity (‰) in 1979.

35.5‰ and E-P was negative. Though E-P and surface salinity distributions were well correlated, Rougerie *et al.* (1980) showed that zonal advection produced an east-west oscillation of the water mass. During the third-quarter (austral winter) of 1979 precipitation was low and the rotation of the tradewinds to the

northeast moved south subtropical water toward the southwest, resulting in high salinity water over the eastern Tuamotu region. During the first quarter, which is the rainy season in the Society Islands, the tradewinds decreased and low salinity water, which increased in extent toward the west, was carried eastward toward Tahiti by the South Equatorial Countercurrent. This countercurrent originates in the Solomon Sea and flows east-southeasterly with speeds inversely proportional to the strength of the southeast tradewinds.

Additional data will permit us to define limits of surface thermohaline fluctuations in the tropical central South Pacific. It is particularly important to know whether the environment found in 1979 was similar to the permanent hydroclimate of French Polynesia.

References

- Dietrich, G. and Kalle, K. (1957) *Allgemeine Meereskunde: Eine Einführung in die Ozeanographie*. Gebrüder Borntraeger, Berlin.
- Donguy, J. R. and Henin, C. (1978) La salinité de surface dans l'Océan Pacifique tropical sud-ouest. *Cahiers ORSTOM serie Oceanographie, Vol. XVI*, 107-136.
- Penman, H. L. (1948) Natural evaporation from open water, bare soil and grass. *Proceedings of the Royal Society of London, Series A, Vol. 193*, 120-145.
- Rougerie, F.; Marec, L. and Gouriou, Y. (1980) Caractéristiques hydroclimatiques de la zone marine de Polynésie Française pendant l'année 1979. Notes et Documents d'Océanographie number 1980-28, Centre ORSTOM, Tahiti.

Francis Rougerie
Office de la Recherche Scientifique et
Technique Outre-Mer
BP 529
Papeete, Tahiti

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